

REPRODUCTIVE BEHAVIOR AND SEXUAL DIMORPHISM
IN THE WHITE-SPOTTED SAWYER
MONOCHAMUS SCUTELLATUS (SAY)

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ABSTRACT

Males of *Monochamus scutellatus* (Say) have longer antennae than females, longer protibiae, and longer protarsal hairs. The species breeds in dead and dying conifers, where large numbers of adults congregate. There is a prolonged (20–40 min) pair-bond involving repeated copulation and oviposition. A male paired with a female uses his antennae to ward off other males. The elongated protibiae and fringed protarsi are evidently adaptations enabling the male to hold on to the female. An evolutionary hypothesis is suggested to account for the prolonged pair-bond in *M. scutellatus*.

Like other species in the genus *Monochamus*, the white-spotted sawyer *Monochamus scutellatus* (Say) is sexually dimorphic (Dillon and Dillon 1941): the antennae is over twice the body length in the male but only ca. 1.25 to 1.35 times the body length in the female; and both the forelegs, particularly the protibiae, and the fringe of bristles on the protarsi are longer in the male than in the female. It is reasonable to expect that sexually dimorphic structures play a role in reproductive behavior. Because of their economic importance, the life histories of several *Monochamus* species are well known (Baker 1973; Browne 1968; Rose 1957; Wilson 1962). Still there has been no detailed account of the reproductive behavior of any *Monochamus* species, nor has there been any attempt to ascertain the role played in reproduction by the sexually dimorphic structures found in this genus. Observations on the reproductive behavior of *M. scutellatus* are thus of interest both in themselves and because of the light they may shed on the evolution of sexual dimorphism in the Monochamini.

On June 22 and 23, 1978, I observed 13 breeding pairs of *Monochamus scutellatus* on recently cut logs of Eastern white pine *Pinus strobus* L. in Monongahela National Forest in Tucker County, West Virginia. One pair was observed for ca. 40 min; three others for ca. 20 min each; and the rest for briefer periods. From these observations a general picture of the species' reproductive behavior emerged.

RESULTS AND DISCUSSION

Breeding activity began in mid-afternoon and continued into early evening. Before ca. 1400 hr, few beetles were seen on the logs, and most of those were females. Some females were engaged in oviposition or at least in cutting oviposition slits, in many of which no egg was laid (Rose 1957); but no contact between sexes was seen before ca. 1400 hr. No initial encounter between male and female was observed; it was inferred that pair-bonds were

generally initiated out of view in crevices in the log pile. It soon became apparent that in this species a relatively prolonged pair-bond is formed, during which both copulation and oviposition take place repeatedly.

Usually when a pair were first seen together, the male would be grasping the female's metathorax with his forelegs. I term this posture the half-mount. In the half-mount the spongy first, second, and third tarsal segments of the male's forelegs were pressed against the female's metasternum on either side. The male's curved protibiae appeared to fit snugly around the female's elytra.

While in the half-mount, the male would begin to palpate the base of the female's elytra with his maxillary palpi. This palpation seemed to stimulate the female to begin walking. As she did so, the male followed, still holding onto her. Copulation began while the female was moving, but soon after intromission she generally stopped. During copulation the male grasped the female with both forelegs and middle legs, while the hind legs remained in contact with the substrate. The male continued to palpate the female's dorsum throughout copulation. The duration of copulation was ca. 20 sec.

After copulation the male resumed the half-mount and continued to maintain contact with the female. Soon the female would begin to move again. The male kept up with her, continuing to grasp her metasternum and palpating her dorsum at least intermittently. The female would then stop and cut an oviposition slit with her mandibles. Cutting lasted ca. 60 sec, during which time the male maintained a half-mount and continued to palpate the female's dorsum. Then the female turned around and began oviposition. Sometimes as the female turned, the male turned also and thus was able to maintain a half-mount during oviposition. Sometimes the male stood to one side of the female during oviposition, his forelegs grasping her transversely across the dorsum. Oviposition lasted ca. 2 min, during which time the male palpated the female's dorsum continuously. Soon after oviposition the female began moving again. She might move to another oviposition site, or copulation might occur again.

While a pair were linked in the half-mount, the male's antennae were directed forward and extended well beyond the female's antennae. When another male approached the pair, the second male's antennae would generally touch those of the paired male. The paired male responded with a quick, jerking movement of his antennae; this usually served to drive off the intruding male. If the latter did not retreat but instead challenged the paired male, the two would lash their antennae with increasing vigor as they closed together. The paired male would dismount from the female, and the two males would rear up on their hind legs, their mandibles locked or one male biting the base of one of the other's antennae. Usually the male originally paired with the female won such fights, but on one occasion an intruder supplanted the original male. In another case the female walked away while the males were fighting; after an hour neither male had found her again. During fights between males, both combatants stridulated continuously.

These observations suggest evolutionary explanations for some aspects of sexual dimorphism of *M. scutellatus*. The elongated, curved protibiae and long protarsal hairs of the male appear to be adaptations for holding the female in the half-mount. There presumably has not been selective

pressure for similar modifications of the forelegs in most other cerambycids because most cerambycids lack the type of pair-bond found in *M. scutellatus*, in which the male maintains prolonged contact with a frequently moving female. Given this type of pair-bond, selection should favor morphological adaptations facilitating the male's maintenance of contact with the female.

The male's long antennae can be viewed as adaptive in that he is able to use them to ward off other males while still maintaining a half-mount. Since *M. scutellatus* breeds in dead and dying pine trees, which are apt to be found only in local concentrations, large numbers of adults will probably congregate at most breeding sites. Under these circumstances, encounters between males will be frequent. Thus we might expect selection to favor long antennae which enable a male to ward off other males without having to leave the female (and thus risk losing her). Dyer and Seabrook (1975) have observed that a *Monochamus* male seems to need antennal contact with another male in order to be aware of the latter's presence; they suggest that such contact would be necessary if a non-volatile secretion were involved in recognition of conspecifics. Both glands and sensory receptors have been identified in the antennae of *M. scutellatus* and *M. notatus* (Dyer and Seabrook 1975). Thus long antennae may enable a paired male to perceive potential rivals over a wider area than would shorter antennae.

We might expect prolonged pair-bonds to evolve in species breeding at sites where large numbers of adults of both sexes congregate. Under these circumstances, if the male leaves the female immediately after copulation, she is likely to copulate soon with other males. But if the male remains with the female while she oviposits and if he copulates with her repeatedly, he increases the likelihood that his genes will be represented in the next generation. Behavioral and morphological adaptations ensuring a prolonged pair-bond will enhance a male's fitness; but (if males are abundant) a female's fitness should not be affected by the duration of the pair-bonds she forms. Thus we should expect such adaptations to be found only in the male, as appears to be the case in *M. scutellatus*.

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